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A new species of *Pythia* Röding, 1798 (Pulmonata, Ellobiidae), from New Ireland, Papua New Guinea.

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Pythia colmani, a new species from the rainforest of New Ireland, Papua New Guinea, is described. The anatomy of the reproductive and nervous systems is studied in detail. The reproductive system agrees with the patterns observed for other species of the genus. The central nervous system, however, presents a slight divergence from patterns previously recognized in the Pythiinae; the right parieto-visceral connective, in the new species, is less than half the length of its left counterpart, whereas in other pythiine species it is slightly longer than half the length of the left parieto-visceral connective. Taking into consideration that the length of the right parieto-visceral connective is nevertheless appreciable, the significance of this deviation from previously recognized diagnostic characters of subfamilial division of the Ellobiidae is minimized. The new species is compared to *Pythia scarabaeus* (Linnaeus, 1758), *P. pyramidata* (Reeve, 1842), *P. argenvillei* Pfeiffer, 1853 and *P. savaiensis* Mousson, 1869, from which it differs mainly by its more slender, longer shell, by the position of the first outer lip tooth and by the shape of the pseudo-umbilicus.

Key words: Ellobiidae, Pythiinae, *Pythia*, morphology, anatomy.

Introduction

Pythia Röding, 1798 is an Indo-Pacific ellobiid genus, common in mangroves from above high tide to completely terrestrial environments. It is readily distinguishable from all other ellobiid genera due to the dorso-ventrally flattened shell with characteristically heavily dentate aperture. However, most described species of *Pythia* are morphologically similar, thus rendering difficult specific separation of some taxa on shell features alone. A review of the genus, based on anatomical characters, is therefore needed to ascertain the taxonomic status of most names.

Anatomical studies of the genus are scanty. Plate (1897) gave the first anatomical account of *Pythia scarabaeus* (Linnaeus, 1758) and Berry *et al.* (1967) provided a detailed description of the reproductive system of the same species. Martins (in press a) discussed the central nervous system of *P. plicata* (Férussac, 1821) and Martins (in press b) figured the internal morphology of the penial complexes of *P. cecillei* (Philippi, 1847) and of *P. fimbriosa* Möllendorff, 1885, alluding to the importance of the latter feature as a diagnostic specific character.

In this work a new species of *Pythia* from New Ireland, Papua New Guinea, is described, and the anatomy of the reproductive and nervous systems is studied.

Materials and Methods

The present study was based on specimens collected on July 18, 1990 at Medina, ca. 110 km South of Kavieng on E coast of New Ireland, Papua New Guinea. Five specimens were preserved in 70% ethanol and 40 specimens are represented by dead shells. Two specimens were dissected under a Wild binocular microscope and drawn using camera lucida. The radula of one specimen was stretched across a cover slip after cleaning with KOH solution. The penial complex was dissected and submitted to critical point drying. Both structures were mounted on stubs, and examined and photographed using a Cambridge Stereoscan 250 Mk2 SEM.

Systematics

Class Gastropoda Cuvier, 1797

Subclass Pulmonata Cuvier, 1817

Order Archaeopulmonata Morton, 1955

Family Ellobiidae H. & A. Adams *in* Pfeiffer, 1854

Subfamily Pythiinae H. & A. Adams *in* Pfeiffer, 1854

Genus *Pythia* Röding, 1798

Pythia colmani, new species.

Description. Shell (Figs. 1A, B; 2A, B, C, D): length to 34 mm, conico-elongated, narrowly pseudo-umbilicated, dorso-ventrally flattened, somewhat thin, finely striated longitudinally, striae marked near suture. Spire decollate in adult shells, moderately high, 9–10 whorls, bearing on each side a carina with whitish varices highlighted by preceding longitudinal dark-brown spots (Fig. 2B); the carinae result from partial retention of the labial callus, at the posterior third of the outer lip, in successive growth periods; first 5 whorls dark-purple, a brownish-green band then developing on the shoulder, increasing and becoming lighter on the following whorls, displacing on the last two whorls the purple color of the early whorls. Body whorl about 65% of shell length, major diameter to 16 mm and minor diameter to 12 mm, greenish-yellow to white with irregularly dispersed brown spots; in lighter, sparsely dotted specimens three equidistant, fine brown lines are visible, the first halfway between the suture and the posterior angle of the aperture, the second arising from the posterior border of the aperture, and the third band arising from the anterior tip of the posterior parietal tooth (Fig. 2C, D); this coloration pattern is usually masked in darker, more heavily dotted specimens. Aperture subvertical, oval, narrow, rounded anteriorly, acute posteriorly; peristome weakly thickened, reflected somewhat and expanded over columella, forming a narrow, roundish pseudo-umbilicus, anterior and posterior margins connecting through a shining callus; inner lip the same color as body whorl, with three subequidistant light-brownish teeth: one strong, oblique columellar tooth, flaring up posteriorly, continuous with columellar lip anteriorly and forming a narrow, roundish

Figure 1. Holotype of *Pythia colmani* Martins, new species (Australian Museum, Sydney C.304290), sl: 31.0 mm. A, apertural view; B, side view.

canal; two parietal teeth, the anterior one strongest, entering aperture horizontally to columellar plane, plate-like, flaring up, sometimes with a small denticle hidden anteriorly at base; posterior parietal tooth vertical to columellar plane, elongated, bifid, sometimes discontinuous, the anterior portion strongest, triangular, tapering posteriorly; outer lip posteriorly retracted to form an angular, white varix, anteriorly expanded, lighter than inner lip and spotted, with 5 subequidistant denticles, the anterior-most (first) lamelliform, entering aperture opposite columellar tooth, the second weakest, the third strongest, oblique, forth and fifth subequal, tuberculiform, the fifth slightly smaller, opposite posterior tubercle of second parietal tooth. Wall of the inner whorls resorbed except for the last two whorls; in the other, upper whorls a small portion of the wall remains attached to the shell.

Radula (Fig. 3A, B): formula [27+19+1+19+27] x 110. Central tooth below the plane of the lateral teeth; base subrhomboid, deeply emarginate; crown very small, oval-elongate, unicuspid, mesocone rounded at tip. Lateral teeth 19, base elongated, slightly oblique, with lateral projections flaring out somewhat symmetrically at about half the length of the base, the inner one smaller, the outer one widely rounded; crown large, covering half of the base, ovoid, with a small median elevation posteriorly, roughly bicuspid anteriorly; a rudimentary endocone and a wide, triangular mesocone with blunt cusp. Transition to marginal teeth indicated by a change of direction of the rows posteriorly relative to the plane of the central and lateral teeth. Marginal teeth 27,

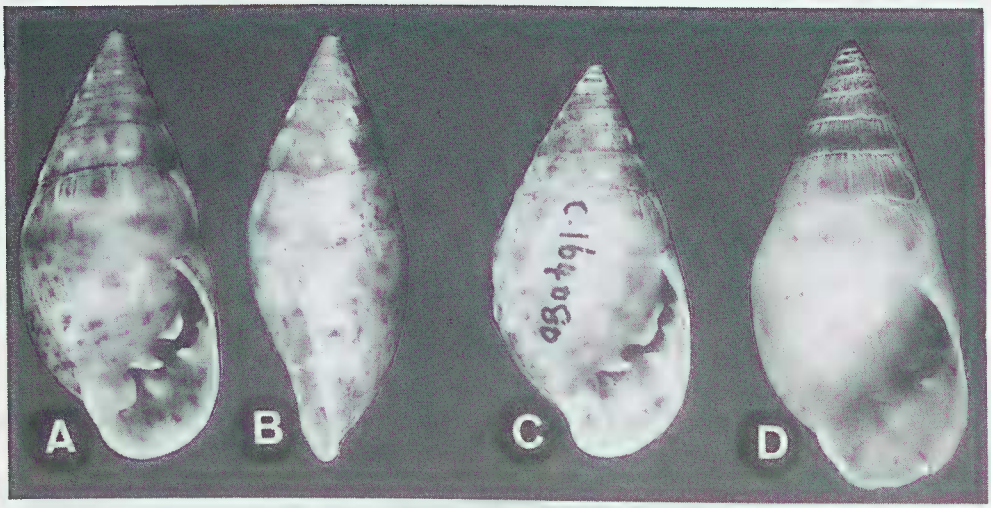

Figure 2. Shells of *Pythia colmani* Martins, new species. A, Apertural view and B, lateral view of the holotype (Australian Museum, Sydney C.304290), sl: 31.0 mm; C, Paratype 1 (Australian Museum, Sydney C.164080), sl: 28.1 mm; D, Paratype 2 (Australian Museum, Sydney C.164080), sl. 32.2 mm.

gradually decreasing in size, with short bases and oval-elongated, rounded crowns; subterminally to the crown cusp, the last 13 marginal teeth develop a small, blunt endocone which becomes as strong as the mesocone in the last 3–4 marginal teeth.

Visceral mass: conical, following external winding of shell, with whorl impressions deeply marked by the remnants of the inner shell walls. Pallial cavity very deep; kidney long, narrow and yellowish, opening by a terminal kidney pore near the posterior bend of the pallial gland; a thick, weakly spiralled pallial organ, located on the left side of the pallial cavity, opens into the mantle skirt groove; when the animal retracts into its shell, the anterior end of the pallial organ occupies the canal formed by the forward expansion of the columellar tooth.

Stomach (Fig. 4): tripartite; cardiac region dilated, thin; mid-portion comprising an anterior muscularized band and a posterior thinner bottom, with a subterminal, dilated

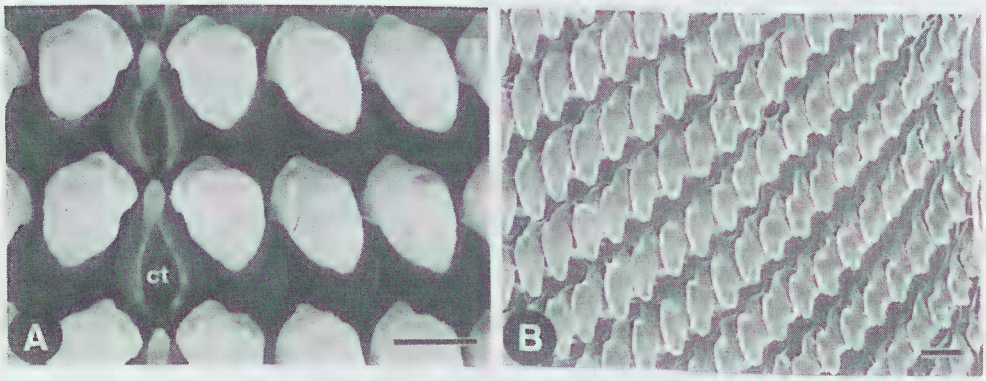

Figure 3. Radular teeth of *Pythia colmani* Martins, new species. A, central and lateral teeth; B, marginal teeth. Scale bars: 30 μm.

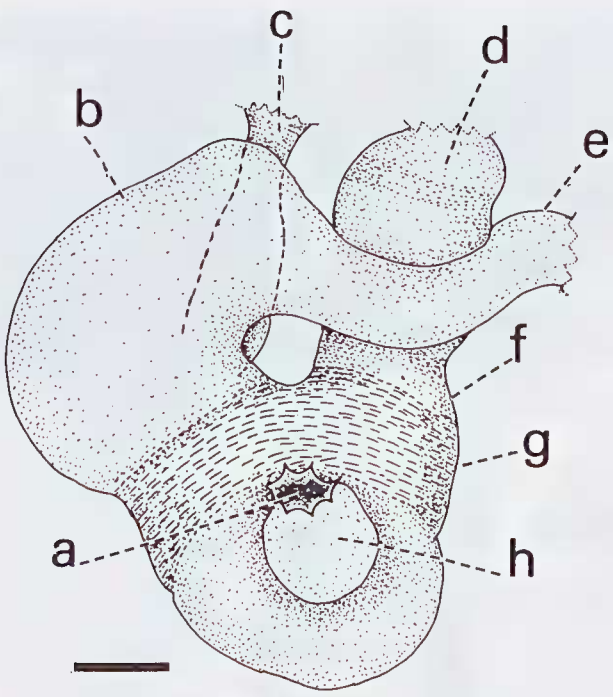

Figure 4. Stomach of *Pythia colmani* Martins, new species. Scale bar: 1 mm.

and thin gastric caecum receiving posterior diverticulum; pyloric region cylindrical, thin.

Reproductive system (Figs. 5A–E, 6A, B): ovotestis embedded in the winding posterior lobe of the digestive gland; proximal portion of the hermaphroditic duct thin, relatively straight, distal portion forming a convoluted, somewhat dilated seminal vesicle; pallial gonoduct hermaphroditic to the vaginal aperture; albumen gland underneath the anterior lobe of digestive gland and intestinal convolutions; two convoluted posterior mucous glands, the distal one more tightly coiled, overlapping proximal end of anterior mucous gland; the latter and the prostate gland cover the entire length of spermoviduct; bursa spherical, fitting underneath proximal posterior mucous gland and albumen gland; duct of bursa as long as spermoviduct, emptying near vaginal opening, opposite pallial gland opening. Pallial gland sharply bent about midway, the two halves about the same thickness, the anterior one tapering to its opening near the female aperture. Penial complex (Fig. 5C) small, club-shaped, with proximal end dilated; penial retractor splitting near penial attachment, inserting subapically at each side of the anterior vas deferens, where the latter enters the penis (Fig. 5D); anterior vas deferens tightly adhering to penial sheath; penis occupying proximal quarter of penial complex, cylindric, finely striated transversely; penial sheath dilated and thin, forming a pouch around the penis, narrowing distally; internal wall of penial pouch finely grooved transversely, distal portion with fine, longitudinal, irregular grooves; a raised longitudinal area marks the site where the anterior vas deferens adheres to the outside wall of the penial sheath, but no true pilasters were observed (Figs. 5E, 6A, B).

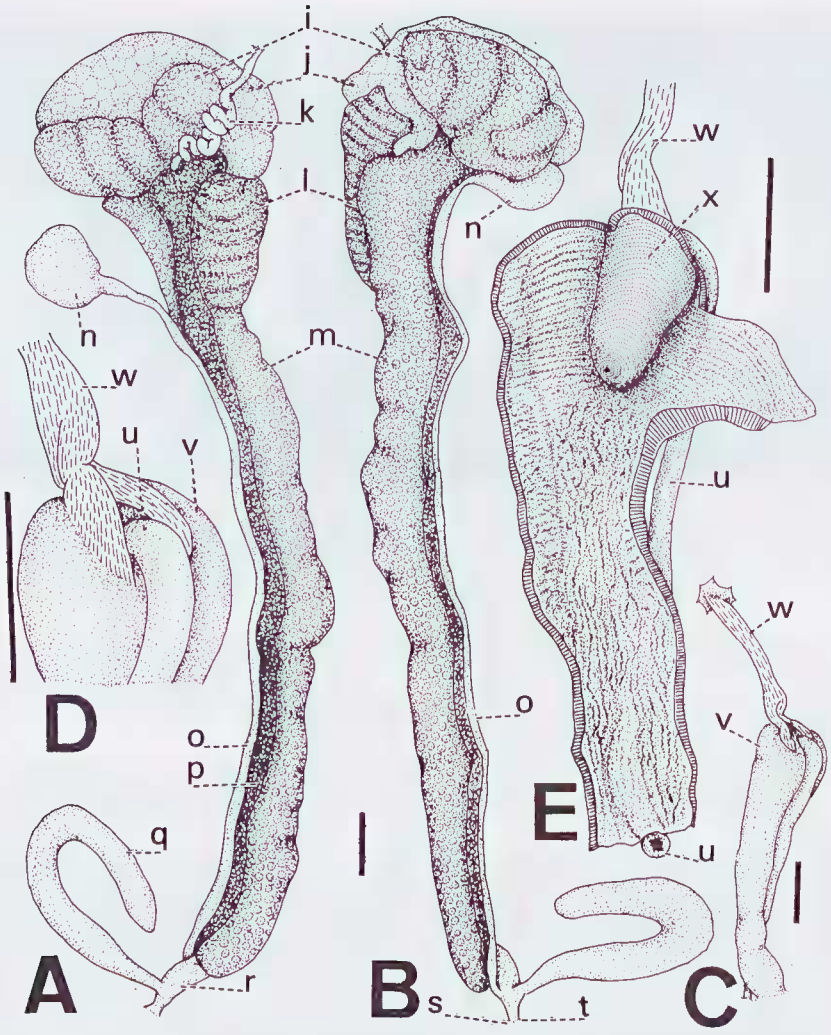

Figure 5. Reproductive system of *Pythia colmani* Martins, new species. A, ventral and B, dorsal views of the hermaphroditic portion, except the gonad; C, penial complex; D, detail of the proximal portion of the penial complex; E, internal morphology of the penial complex. Scale bars: 1 mm.

Nervous system (Fig. 7): cerebral commissure somewhat longer than the width of a cerebral ganglion; cerebro-pleural connectives about half as long as cerebro-pedal connectives; visceral nerve ring very wide, with clear remnants of chiastoneury; left pleuro-parietal connective very short, half the length of the right one; left parieto-visceral connective very long, passing underneath right parieto-visceral connective to connect with right side of visceral ganglion.

Type locality. Medina, ca. 110 km S of Kavieng on E coast of New Ireland, Papua New Guinea, ca. 2°56'S, 151°22'30"E. Location of type series. Holotype: Australian Museum, Sydney, C.304290; paratypes (32 dry shells and 4 wet), Australian Museum,

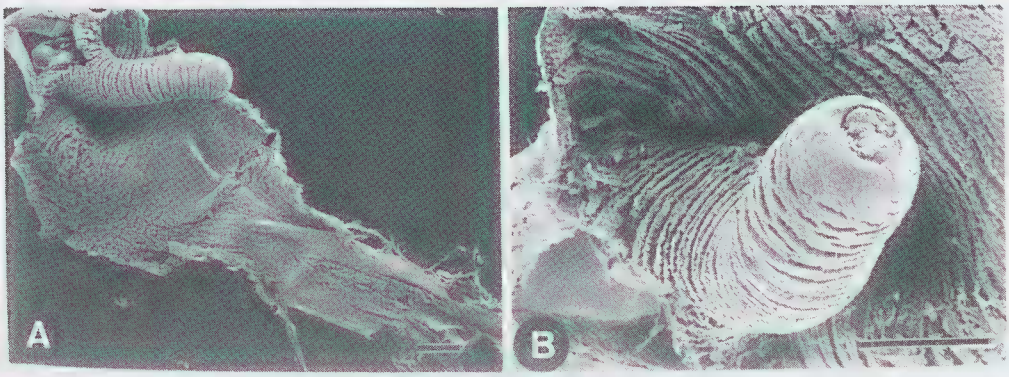

Figure. 6. Internal morphology of the penial complex of *Pythia colmani* Martins, new species. A, overall view; B, penis. Scale bars: 300 µm.

Sydney, C.164080; one additional dry paratype was deposited in each of NHM, London, MNHN, Paris, USNM, Washington, LACM, Los Angeles, ZM, Amsterdam; NMNZ, Welligton, and Natal Museum, Pietermaritzburg.

Etymology. This species is named after P.H. Colman, Technical Officer, Australian Museum, Sydney, who collected and kindly provided the specimens and patiently awaited the completion of this study.

Habitat notes. *Pythia colmani* was collected in limestone doline, at about 100 m altitude, in rainforest.

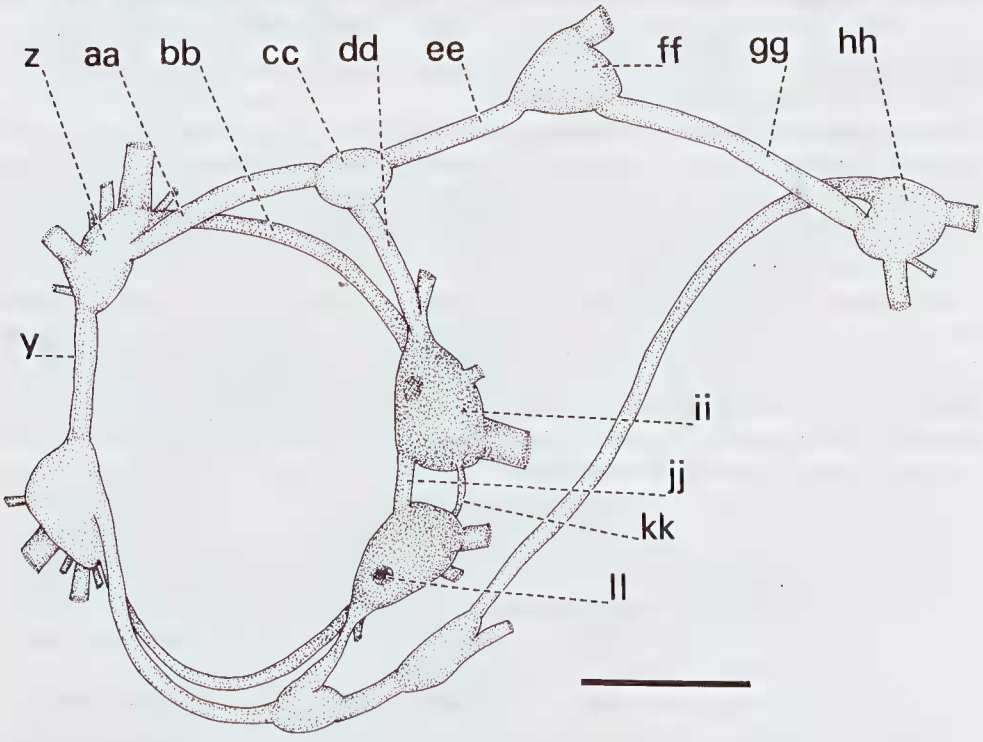

Figure 7. Central nervous system of *Pythia colmani* Martins, new species. Scale bar: 1 mm.

Remarks. *Pythia colmani* belongs to the large and variable group of mottled *Pythia* species which includes the widespread *P. scarabaeus*. The comparisons that follow are not intended to unravel the taxonomic position of the few species in question. Such a quest would definitely require a study of the anatomy, since conchological characters alone sometimes seem inconclusive, as shown by the morphological variability seen throughout the distributional range of the genus. *Pythia colmani* is more slender than *P. scarabaeus*. In the latter species the pseudo-umbilicus is wide and shows clearly the anterior portion of the previous last whorl, whereas in the new species the pseudo-umbilicus is narrow and completely hides the anterior tip of the previous last whorl. Also, the anteriormost outer lip tooth in *P. scarabaeus* is located nearer the plane of the anterior parietal tooth, whereas in the new species the first outer lip tooth is located opposite the columellar tooth. *Pythia pyramidata* was described by Reeve (1842: 221; fig. 12) as "the most oblong of the different forms"; however, the yellowish color of the mouth, the pseudo-umbilicus of the "*scarabaeus*"-type and the wider base that gives it the pyramidal outline, set this species apart from the new species described here. The slender, Australian *Pythia argenvillei* Pfeiffer, 1853 is comparable to *P. colmani*, but is smaller; Pfeiffer (1853) recorded a length of 26 mm and maximum diameter of 13 mm for his species. The position of the anterior outer lip tooth approaches that observed in the new species. However, the pseudo-umbilicus of *P. argenvillei* is similar to that observed in *P. scarabaeus,* apparently justifying Smith's (1992) decision to consider Pfeiffer's species a junior synonym of *P. scarabaeus*. Mousson (1869) described *Pythia savaiensis* from Savai'i and Manua, Samoa Islands, which also can be compared with the new species. Mousson's species, although somewhat more elongated than most *P. scarabaeus*, is stouter than *P. colmani* and has only four teeth in the outer lip, of which the first one lies opposite the anterior parietal tooth. The pseudo-umbilicus of *P. savaiensis* resembles that of *P. scarabaeus*, thus pointing at a close relationship between these two species.

The reproductive system of *Pythia colmani* conforms to the patterns previously observed for other species in the genus (Plate, 1897; Morton, 1955; Berry *et al.,* 1967). The penis shows fine transverse striation, similar to that recorded by Martins (in press b) for *P. cecillei* and *P. fimbriosa*, from Hong Kong; such striated pattern seems to be a typical feature of the genus.

The central nervous system of the new species differs somewhat from that of other *Pythia* species studied by Martins (in press a, b) in that the right parieto-visceral connective, although long, is much shorter than its left counterpart, a situation somewhat similar to that observed in the ellobiine *Auriculastra subula* (Quoy & Gaimard, 1832) (Martins in press b, c). Martins (in press a, b) recognized three types of central nervous systems in the Ellobiidae: 1) Pythiinian, with large visceral ring and with long right parieto-visceral connective; 2) Ellobiinian-Carychiinian, with wide visceral nerve ring and short right parieto-visceral connective; 3) Pedipedinian-Melampinian, with short visceral nerve ring. The situation in *Pythia colmani*, although not invalidating the subfamilial patterns referred to above, shows that some variability is to be expected, and that phylogenetic relationships are more meaningful when a conjunction of characters is analyzed (e.g. those of the reproductive system).

Lack of juvenile material prevented observation of the protoconch of *P. colmani*, for *Pythia* species exhibit decollation of the protoconch early in their growth stages (Harry, 1951).

Pythia colmani has assumed a completely terrestrial habitat, for it was found at an altitude of 100 m, in rainforest. The terrestrial habits of the species of *Pythia* have been well noted before (Morton, 1955), but they have not previously been recorded this far inland. Perhaps the development of the pallial organ is related to this complete terrestriality.

Acknowledgements

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Literature cited

Berry, A. J., S. C. Loog & H. H. Tum, 1967. Genital systems of *Pythia, Cassidula* and *Auricula* (Ellobiidae, Pulmonata) from Malayan mangrove swamps. Proceedings of the Malacological Society of London 37: 325–337.

Harry, H. W., 1951. Growth changes in the shell of *Pythia scarabeus* (L.). California Zoological Club 2: 7–14.

Martins, A.M.F., In press a. Anatomy and systematics of the western Atlantic Ellobiidae (Gastropoda, Pulmonata). Malacologia.

Martins, A.M.F., In press b. Relationships within the Ellobiidae. In 'Origin and evolutionary radiation of the Mollusca' (ed. J. Taylor). Oxford University Press.

Martins, A.M.F., In press c. The anatomy of *Auriculastra subula* (Quoy & Gaimard, 1832) (Pulmonata, Ellobiidae) from Hong Kong, with a comment on the systematic position of *Auriculastra* Martens, 1880. Asian Marine Studies.

Morton, J.E. 1955. The evolution of the Ellobiidae with a discussion on the origin of the Pulmonata. Proceedings of the Zoological Society of London 125: 127–168.

Mousson, A. 1869. Faune malacologique terrestre et fluviatille des îles Samoa, publiée d'après les envois de M. le Dr. E. Graeffe. Journal de Conchyliologie 17: 323–390.

Plate, L. H. 1897. Über primitive (*Pythia scarabeus* [L.]) und höchgradig differenzierte (*Vaginula gayi* Fischer) Lungschnecken. Verhandlungen der Deutschlander Zoologische Gesellschaft 7: 119–140.

Pfeiffer, L., 1853. Neue *Pythia*-arten. Zeitschrift für Malakozoologie 10: 189–192.

Reeve, L. 1842. On the genus *Scarabus*, a small group of Pulmobranchiate Mollusks of the family Auriculacea. The Annals and Magazine of Natural History 9: 218–221.

Smith, B. J., 1992. Non-marine Mollusca. In 'Zoological Catalogue of Australia' (ed. W.W.K. Houston) Vol. 8: xii+405 pp. AGPS, Canberra.

Abbreviations used in the figures

a, posterior opening to the digestive gland; aa, cerebro-pleural connective; b, cardiac portion of stomach; bb, cerebro-pedal connective; c, anterior opening to the digestive gland; cc, pleural ganglion; ct, central radular tooth; d, intestine; dd, pleuro-pedal connective; e,oesophagus; ee, pleuro-parietal connective; f, pyloric portion of the stomach;ff, parietal ganglion; g, muscular band of mid-stomach; gg, parieto-visceral connective; h, gastric caecum; hh, visceral ganglion; i, first posterior mucous gland; ii, pedal ganglion; j, albumen gland; jj, pedal commissure; k, seminal vesicle; kk, sub-pedal commissure; l, second posterior mucous gland; ll, statocyst; m, anterior mucous gland; n, bursa; o, duct of bursa; p, prostate; q, pallial gland; r, vagina; s, opening to seminal groove; sl, shell length; t, female genital opening; u, anterior vas deferens; v, penial complex; w, penial retractor muscle; x, penis; y, cerebral commissure; z, cerebral ganglion;